REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application

Disposition of Claims

Claims 2-9, 11-23, 25-38, 40, 45, and 46 are pending in this application. Claims 45 and 46 are independent. The remaining claims depend, directly or indirectly, from claims 45 and 46.

Rejections under 35 U.S.C. § 103

Claims 2-7, 14-23, 25-38 and 45-48 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over "The Operational Mechanics of The Rock Bit," by Ma, *et al.* (hereinafter "Ma"), in view of U.S. Patent No. 6,695,073, issued to Glass, *et al.* (hereinafter "Glass"), further in view of U.S. Patent Publication No. 2001/0020552 ("Beaton").

Claims 8-9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma and Glass in view of Beaton, and further in view of U.S. Patent No. 6,039,131 ("Beaton2").

Claims 8-9 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma and Glass in view of Beaton, and further in view of "Drag-Bit Performance Modeling," SPE Drilling Engineering, June 1989 by Warren *et al.* ("Warren").

A *prima facie* case of obviousness requires that <u>all claim limitations</u> be taught or suggested by the prior art. *See In re Royka*, 490 F.2d 981 (CCPA 1974). Thus, in a 103 rejection, when combining prior art elements, the Examiner "must articulate the following: (1) a finding that the prior art <u>included each element claimed,</u> although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference...." MPEP § 2143(A).

Turning to the rejection of claims 2-7, 14-23, 25-38 and 45-48 over Ma, Glass, and Beaton, this rejection is respectfully traversed.

Ma relates to the kinematics of a roller cone bit. While Ma discloses various force determinations, Ma does not specifically disclose or suggest evaluating a bit structure on the basis of radial force, much less on the basis of a ratio of radial force to applied weight on bit.

Glass teaches a method for designing a bit that involves balancing forces and torques acting on cutters while a bit is drilling through a transitional section between soft and hard rock formations. Specifically, Glass discloses optimizing a fixed-cutter drill bit so that cutter forces and torques are evenly distributed not only during drilling of homogeneous rock, but also in transitional formations (Glass, Abstract).

Beaton discloses bi-center drill bits having certain arrangements of pilot blades and pilot sections and reaming blades and reaming sections (Beaton, Abstract). More specifically, Beaton relates to bi-center drill bits that are force balanced over the entire bit by calculating the forces exerted by each PDC cutter individually and selecting the locations of the blades and the PDC cutters thereon such that the sum of all the forces exerted by each of the cutters has a net

imbalance of less than about 10 percent of the total axial force exerted on the bit (known in the art as the "weight on bit").

Independent claim 45 requires, in part, a method for designing a drill bit, including: determining radial forces acting on a selected drill bit during simulated drilling; summing magnitudes of the radial forces with respect to a direction to generate a sum of the radial forces; comparing the sum of the radial forces to an applied weight on bit; generating a ratio between the sum of the radial forces and the applied weight on bit; adjusting at least one parameter of the selected drill bit based on the generated ratio *until the magnitude of the radial forces is less than a predetermined value for a preselected time for a simulated drilling*; and outputting a drill bit design based on the generated ratio and the adjusting.

Independent claim 46 requires, in part, a method for designing a bottomhole assembly, including: determining radial forces acting on a bottom hole assembly during simulated drilling, said bottomhole assembly including a drill bit; summing magnitudes of the radial forces with respect to a direction to generate a sum of the radial forces; comparing the sum of the radial forces to an applied weight on bit; generating a ratio between the sum of the radial forces and the applied weight on bit; adjusting at least one parameter of the bottom hole assembly based on the generated ratio *until the generated ratio is less than a predetermined value for a preselected time for a simulated drilling*; and outputting a bottom hole assembly design based on the generated ratio and the adjusting.

Initially, Applicant notes that both independent claims 45 and 46 require, in part, adjusting at least one parameter of the selected drill bit based on the generated ratio until the

magnitude of the radial forces is less than a predetermined value <u>for a preselected time</u> for a simulated drilling. In the Office Action dated April 5, 2010 ("Office Action"), pages 2 and 3, the Examiner maintains that because "Applicant admits... that time passes during [the] boxed simulation cycle [of Glass]" that "Glass [therefore] teaches the limitation of preselected time." Applicant notes that the "boxed simulation cycle" of Glass (labeled as Figure 3A in Glass) does not disclose or suggest the required element of "a preselected time" as required by claims 45 and 46, as discussed below. Figure 3A is reproduced below:
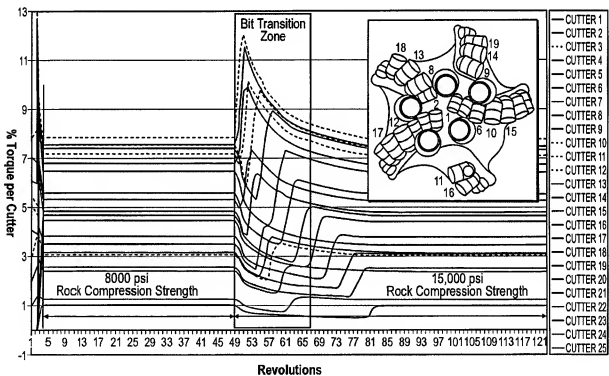

Figure 3A.

As described in Glass, Figure 3A shows measurements resulting from a simulation (Glass, col. 5, lines 24-25). Applicant notes that simulations necessarily must occur as time passes. Glass explains that Figure 3A shows a plot of various measured torques for typical PDC bit designs as the bit drills through rock varying in hardness, and inserts showing corresponding cutter damage (Glass, col. 5, lines 24-31). In particular, Glass discloses using an Amoco model[1] (also referred to as "Amoco program") to simulate down-hole conditions while simulating drilling through a transition zone of differing compressive strengths and the data from the Amoco model is then plotted graphically to represent the percent torque per cutter distribution under a specified drilling condition. This is exemplified by Figure 3A and its associated text. Thus, Glass is directed to using outputs from the Amoco program to generate torque per cutter distribution graphs, and using those graphs to reduce local maximums in torque on cutter for transitional regions.

Applicant respectfully asserts that it is not possible for Glass, and the use of the Amoco model, to teach or suggest the use of time as a variable, as required in part by the present claims, and this is exemplified in several ways. For example, the modeling method described by the Amoco model only outputs a single numeric answer, such as the volume of rock removed by a cutter, the total weight-on-bit, bit torque, etc. Thus, the Amoco model does not provide a dynamic model or simulation of drilling. This is further demonstrated by the fact that the Amoco model does not provide any use of time as a variable, or any suggestion of using time as a variable. Thus, the Amoco model is limited to providing a static model. Therefore, Glass and the Amoco model, do not teach or suggest the use of time as a variable, or the selection of a pre-selected amount of time.

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[1] When referring to the "Amoco Model," the '073 patent is referring to the Amoco drag bit force balance program described in "Drag Bit Performance Modeling", Society of Petroleum Engineers #15618 1986.

In addition, Applicant notes that Figure 3A in Glass (a torque distribution graph) only provides a measurement of torque based on revolutions of a drill bit. In other words, such a torque distribution graph is only concerned with ft-lbs of torque that are applied to a cutting element at a certain point of revolution of the drill bit within a formation. Applicant further notes that time is relative when taking measurements based on the revolution of a drill bit because the amount of time per revolution necessarily depends on the speed of revolution. Thus, it is not possible for time to be measured or pre-selected based on the data provided in Figure 3A and its associated text.

Turning to the Examiner's assertion that "Glass teaches the limitation of preselected time" because "Applicant admits... that time passes during [the] boxed simulation cycle [of Glass]" (*see* Office Action, pages 2 and 3), Applicant respectfully disagrees. To Applicant's knowledge, there is presently no known method of stopping time. In other words, time is always progressing. Thus, Applicant acknowledges, as asserted by the Examiner, that during any type of simulation, time does indeed pass. However, Applicant maintains that the fact that time does not stop does not teach or suggest selecting a <u>preselected</u> amount of time. Selecting a preselected time necessarily requires performing an action (*e.g.*, preselecting an amount of time) prior to a step that will use the action (*e.g.*, measuring variables during the preselected amount of time). Applicant does not see how preselecting an amount of time could be taught or suggested by the well-known fact that time does not stop, as asserted by the Examiner. Thus, contrary to the Examiner's assertion, there is no teaching or suggestion that the particular timeframe shown in Figure 3A is comparable to a <u>preselected</u> time.

The illogicality of the Examiner's basis of argument (that time passes) is further exemplified by the Examiner's argument that "[u]nless time does not pass during the simulation… Glass appears to teach the claimed limitation." Applicant notes that time will indeed not stop and this is therefore an invalid argument.

In addition, Applicant also notes that the proper legal test for obviousness is explained in MPEP § 2143, which states that "[t]he key to supporting any rejection under 35 U.S.C. § 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. The Supreme Court in KSR noted that the analysis supporting a rejection under 35 U.S.C. § 103 should be made explicit. " Further, when combining prior art elements, the Examiner "must articulate the following: (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference…." MPEP § 2143(A). Thus, the proper legal test for obviousness does not involve extrapolation. Applicant respectfully asserts that Glass does not teach a limitation of a preselected amount of time, and the Examiner does not clearly address each claimed limitation. For example, the Examiner appears to be extrapolating from the fact that time exists in order to argue that this teaches or suggests preselecting a time.

Further, in determining obviousness, the Examiner can only take into account knowledge that was within the level of ordinary skill in the art at the time the claimed invention was made. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971). Use of knowledge gleaned only from the Applicant's disclosure is improper. *Id.* The Examiner appears to be engaging in hindsight

reconstruction using the present application as a guide, to arbitrarily pick and choose isolated features of Ma, Glass, and Beaton to arrive at the claimed limitations. With respect to Figure 3A, the Examiner is improperly inferring the time axis is the same as a <u>preselected</u> time; however the time axis does not suggest a preselected time. Having an event happen over time does not teach or suggest an event occurring <u>for</u> a preselected time.

Still further, Applicant also notes that the invention as a whole must be considered in an obviousness determination. The "invention as a whole embraces the structure, its properties, and the problem is solves." *In re Wright*, 848 F.2d 1216 (Fed. Cir. 1988). All limitations, including the specifically claimed properties recited in the claims of the present application, must be considered in an obviousness determination. In making an obviousness determination, the PTO is "obligated to consider all the evidence of the properties of the claimed invention as a whole, compared with those of the prior art." *In re Dillon*, 919, F.2d 688 (Fed. Cir. 1990). Furthermore the Applicant respectfully notes that, "focusing on the obviousness of substitutions and differences, instead of on the invention as a whole, is a legally improper way to simplify the often difficult determination of obviousness." *Gillette Co. v. S.C. Johnson & Son, Inc.*, 919 F.2d 720 (Fed. Cir. 1990). In accordance with Federal Circuit precedence, in forming a proper rejection under 35 U.S.C. § 103(a), the Examiner must consider the invention as a whole, *i.e.*, the entire disclosure of Glass, while not merely focusing on whether it would be obvious to select a time from a timeline. As the Examiner in this case has simply asserted that the presence of time in Glass' simulations is analogous to having a "preselected time," the Examiner has improperly focused on a substitution, rather than on

the invention as a whole. The specification of Glass provides no support for a reading of Figure 3A to the contrary of the reading submitted by the Applicant.

In addition, the Examiner asserts that "[e]ven is (sic) Ma and Glass are presumed not to explicitly teach outputting a drill bit design on the generated ratio between the WOB... and radial forces... such suggestion is clearly present in Glass Col.5 Lines 8-24." Applicant respectfully disagrees with Examiner's assertion and notes that col. 5, lines 8-24 in Glass discloses "adjusting cutter size, blade position, bit profile and cutter distribution" and using "tool face control" to effectively apply weight on bit to achieve competitive rates of penetration. This selected text does not teach or suggest outputting a drill bit design based on a generated ratio between the WOB and radial forces.

In fact, Glass is silent with respect to the ratio. Glass teaches summing cutter forces to the orthogonal components of the force system required to drill at the input parameters. The orthogonal components are summed at the origin of the bit coordinate system. *See* Glass, col. 4, lines 30-33 and col. 4, lines 35-36. These calculations are an output that may be generated once per revolution as a percentage of weight on bit or torque on bit. *See* Glass, col. 4, lines 53-55. Glass does not disclose using these calculations as anything other than data output. In fact, Glass exclusively teaches balancing cutter loads. *See*, for example, Glass, Abstract, col. 5, lines 61-64, and Claims 1 and 3. Glass does not teach adjusting design parameters based on a ratio between radial forces and weight on bit to obtain a design, as required in part by claims 45 and 46.

Ma and Beaton do not provide that which Glass lacks. There is no teaching or suggestion in Ma or Beaton to adjust at least one parameter of the selected drill bit based on the generated ratio until the magnitude of the radial forces is less than a predetermined value <u>for a preselected time</u> for a simulated drilling, as required by the claimed invention. Independent claims 45 and 46 are patentable over Ma, Glass, and Beaton, considered alone or in combination. Dependent claims are patentable for at least the same reason. Therefore, withdrawal of this rejection is respectfully requested.

Additionally, Applicant respectfully notes that the Office Action appears to be incomplete. For example, on page 6, the Examiner ends in an incomplete sentence accompanied by a note to "explain how Beaton2 teach (sic) 'adjusting a parameter based on a generated ratio.....for a preselected amount of time.'" *See* Office Action, page 6. Applicant respectfully requests that the Examiner provide a complete Response to Claim Rejections.

Turning to the rejection of claims 8 and 9 over Ma, Glass, Beaton, and Beaton2, this rejection is respectfully traversed.

Beaton2 discloses bi-center bits designed such that the imbalance forces that result from the cutting action of the reaming cutters are offset by forces resulting from the cutting action of the remaining cutters so that the overall total of the imbalance forces on the bit is minimized. (Beaton2, col. 3, lines 35-41).

Beaton2 does not provide that which Ma, Glass, and Beaton lack. More specifically, Beaton2 does not teach or suggest adjusting a parameter based on a generated ratio until the

magnitude of the radial forces (or generated ratio) is less than a predetermined value for a preselected amount of time, as required in part independent claims 45 and 46. Therefore, independent claims 45 and 46, are patentable over Ma, Glass, Beaton, and Beaton2, whether considered separately or in combination. Dependent claims, including claims 8-9, are allowable for at least the same reasons. Thus, withdrawal of this rejection is respectfully requested.

Turning to the rejection of claims 8 and 9 over Ma, Glass, Beaton, and Warren, this rejection is respectfully traversed.

Warren discloses modeling polycrystalline-diamond-compact (PDC) bit designs and modeling the forces required to remove a fixed volume of rock with a single cutter applied to different PDC bit designs. Warren further discloses results of comparing such models to laboratory drilling tests for different bit designs in different rocks to determine whether the model predictions are comparable to the measured data. Warren fails to disclose that which Ma and Glass lack. In fact, Warren suffers from a similar deficiency as Ma, in that it also fails to show or suggest evaluating a bit on the basis of a ratio of radial force to applied weight on bit.

Warren does not provide that which Ma, Glass, and Beaton lack. More specifically, Warren does not teach or suggest adjusting a parameter based on a generated ratio until the magnitude of the radial forces (or generated ratio) is less than a predetermined value for a preselected amount of time, as required in part independent claims 45 and 46. Therefore, independent claims 45 and 46, are patentable over Ma, Glass, Beaton, and Warren, whether

considered separately or in combination. Dependent claims, including claims 8-9, are allowable for

at least the same reasons. Thus, withdrawal of this rejection is respectfully requested.

Applicant believes this reply is fully responsive to all outstanding issues and places

this application in condition for allowance. If this belief is incorrect, or other issues arise, the

Examiner is encouraged to contact the undersigned or his associates at the telephone number listed

below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591

(Reference Number [05516/148002]).

Dated: August 5, 2010   Respectfully submitted,

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